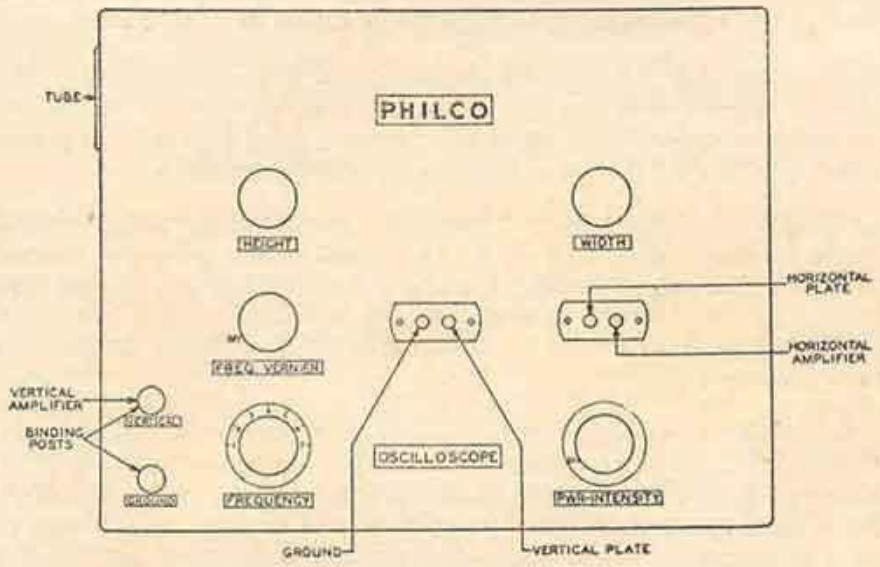
PHILCO MODEL 022

CATHODE RAY OSCILLOSCOPE

(Self-Synchronizing)

The Philco Model 022 is a simple, portable, and rugged, yet complete oscilloscope for use with other Philco test equipment for radio receiver trouble analysis and many other applications. The intelligent operation of your Philco Model 022 involves some knowledge of the fundamental principles of the cathode ray tube which forms the nucleus of the oscilloscope.



THE CATHODE RAY TUBE

The cathode ray tube consists of six essential parts:

(1) the electron gun—for producing the electron stream;

(2) the grid—for controlling the intensity of the electron stream;

(3) accelerating plate—for increasing the velocity of the electron stream and so producing the image;

(4) focusing grid—for focusing the electrons upon the screen;

(5) the deflecting plates—for deflecting the electron stream to create the desired image pattern; and

(6) the screen—to produce a visual image dependent upon the position of the stream.

The electrons given off by the cathode are focussed and accelerated, so that they flow through the tube in a thin stream at a high rate of speed. When this stream impinges upon the screen, a luminous spot appears.

If this stream can be made to move from side to side or up and down, the spot will move in a corresponding manner. If this movement is fast enough and recurrent, the spot will appear as a steady pattern.

Since the electron beam actually consists of electrons, and therefore has a negative electrostatic potential, movement of the beam is easily accomplished by means of electrostatic forces. A positive potential in the vicinity of the beam will cause a movement toward the external voltage, and a negative potential will cause a movement in the opposite direction. The degree of movement is proportional to the voltage which causes it.

Cathode ray tubes of the electrostatic deflection type contain two pairs of deflecting plates. These pairs are located with their axes perpendicular and in such a position that the axis of one pair is horizontal and that of the other is vertical. These two pairs of plates are used to produce horizontal and vertical electron beam deflection.

If a sine wave is applied to the vertical deflecting plates, the electron beam will be deflected up and down at the same frequency as the impressed wave, and a vertical straight line trace will be produced. This image would be useful only in determining the peak value of the voltage under consideration. However, if the beam is now moved uniformly from left to right, the impressed wave will appear in its true form.

Since the cathode ray tube has definite limits, and it is impossible to move the beam indefinitely in any one direction, in practice, the beam is moved from left to right far enough to trace one cycle, then returned to its starting point to repeat the process. In this manner, one cycle of the external wave appears stationary on the screen.

This timing wave is produced by a "sawtooth" generator, the output of which is connected to the horizontal deflecting plates. The output of this generator increases linearly to a certain point, then drops quickly to zero and the cycle repeats. This generator circuit, consisting of a gas filled triode (884) and suitable associated circuits, provides a continuously variable frequency, permitting the study of voltages at any frequency up to the limit of the generator.

The examination of voltages of small magnitude would be impossible if amplification were not provided to produce a readable deflection of the electron beam. The Philco Model 022 contains two amplifiers, one each for the vertical and horizontal plates. The deflection sensitivity of the instrument on either set of plates is approximately 4.0 volts per inch of deflection with maximum amplification. With the amplifiers out of the circuit, the deflection sensitivity is 80 volts per inch. These amplifiers have essentially constant output up to 100 kilocycles. The gain of the vertical and horizontal amplifiers is regulated by the "Height" and "Width" controls respectively.

CONTROLS

The operator should become thoroughly familiar with the controls of the Model 022 before proceeding with any adjustments. Observe the illustration carefully for location of the controls. These are: (left to right) Top row: Amplifier gain controls—(1) Height, (2) Width; Middle row: (3) Frequency vernier, (4) Terminal panel number 1, (5) Terminal panel number 2; Bottom row: (6) Frequency, (7) Power-Intensity.

The vertical and ground posts in the lower left hand corner connect to the vertical amplifier and ground.

The terminal panel connections are: (from left to right) ground, vertical plate, (without amplifier) horizontal plate, and horizontal amplifier.

Focus adjustment is by means of a screw on the back of the case.

PRELIMINARY ADJUSTMENTS

Insert the power cord in 115 volt, 50-60 cycle outlet. Turn the Power-Intensity Switch on. Allow the tubes to warm up for about one minute. Retard "Height" and "Width" controls completely (counter-clockwise). Advance "Power-Intensity" control until a small spot is visible on the screen. Advance "Frequency Vernier" control about half its range. Adjust "Focus" control (on back of instrument) until spot is smallest possible. Advance "Width" control sufficiently to cause the straight line horizontal trace just to cover the screen. If this trace is not exactly horizontal, proceed as follows:

(1) Disconnect power supply;
(2) Remove cathode-ray tube shield;
(3) Remove panel;
(4) Loosen screws in cathode-ray tube socket;
(5) Reconnect power supply, allow tubes to warm up and advance "Width" control as above;
(6) Rotate cathode-ray tube until trace is exactly horizontal;
(7) Tighten socket screws, replace cover panel and tube shield;

The above adjustments need not be made more than once for each tube.

GENERAL PRECAUTIONS

(1) Do not allow a bright spot or straight line trace to remain on the screen over ten seconds.

(2) Always retard Power-Intensity control except when actually making observations.

(3) Always use as little intensity as possible to give a readable image.

(4) No external voltage of a higher potential than five hundred (500) volts should be connected to any of the binding posts or terminals of this instrument.

(5) Connect a ground lead to the binding post marked "Ground" in the lower left hand corner of the oscilloscope panel.

WAVE ANALYSIS

For analysis of frequencies up to 100 KC, proceed as follows:

(1) Turn "Power-Intensity" switch on.

(2) Connect the terminals of the voltage source under observation to the binding posts at the bottom left corner of the panel. The low side of the circuit should be connected to the "Ground" post and the high side to the "Vertical" post.

(3) Advance the intensity control just enough to provide a readable image.

(4) Advance the "Height" and "Width" controls until the image is of a convenient size and in proper proportion.

(5) Adjust the frequency of the sweep circuit, by means of the "Frequency" and "Frequency Vernier" controls until the desired number of cycles of the observed wave appear on the screen. The range available at each of the positions of the "Frequency" control is as follows:

(1) 15—50 cycles
(2) 35—120 cycles
(3) 80—290 cycles
(4) 220—840 cycles
(5) 600—2100 cycles
(6) 1250—5000 cycles
(7) 3600—15000 cycles

The sweep generator is turned "Off" by turning the "Frequency Vernier" control all the way to the left.

It should be noted that at no time should the frequency of the sweep circuit be higher than that of the voltage under observation, but may be lower. For example: If the external voltage has a frequency of 400 cycles, the sweep frequency may be 400, 200, 133, 100, 80. These frequencies will give a pattern on the screen of 1, 2, 3, 4, and 5 cycles respectively.

In this manner a rapid and accurate check may be made to determine the presence of distortion in any A. C. signal—for example, the output of an audio amplifier. The observed trace from the output should be an exact copy of the input, where a sine wave is used. The Philco Model 044 Audio Signal Generator is especially recommended for such service, since its wave form is essentially a pure sine wave at all frequencies. If the output wave form is not a sine wave but is symmetrical about the zero axis and contains peaks or irregularities, it is evident that odd-order distortion exists (3rd, 5th, 7th, 9th, etc. harmonics of the fundamental). If the wave is not symmetrical about the zero axis, even-order distortion is present (2nd, 4th, 6th, 8th, etc. harmonics).

FREQUENCIES ABOVE 100 KILOCYCLES

For measurements of voltages at frequencies beyond the range of the self-contained sweep circuit, access is provided to the vertical and horizontal deflecting plates and amplifiers through the terminal panels as described under *Controls*.

By use of these terminals, inspection of voltages at very high frequencies may be made, either by the harmonic sweep method or by the introduction to the horizontal deflecting plates of a sawtooth sweep circuit of the proper frequency.

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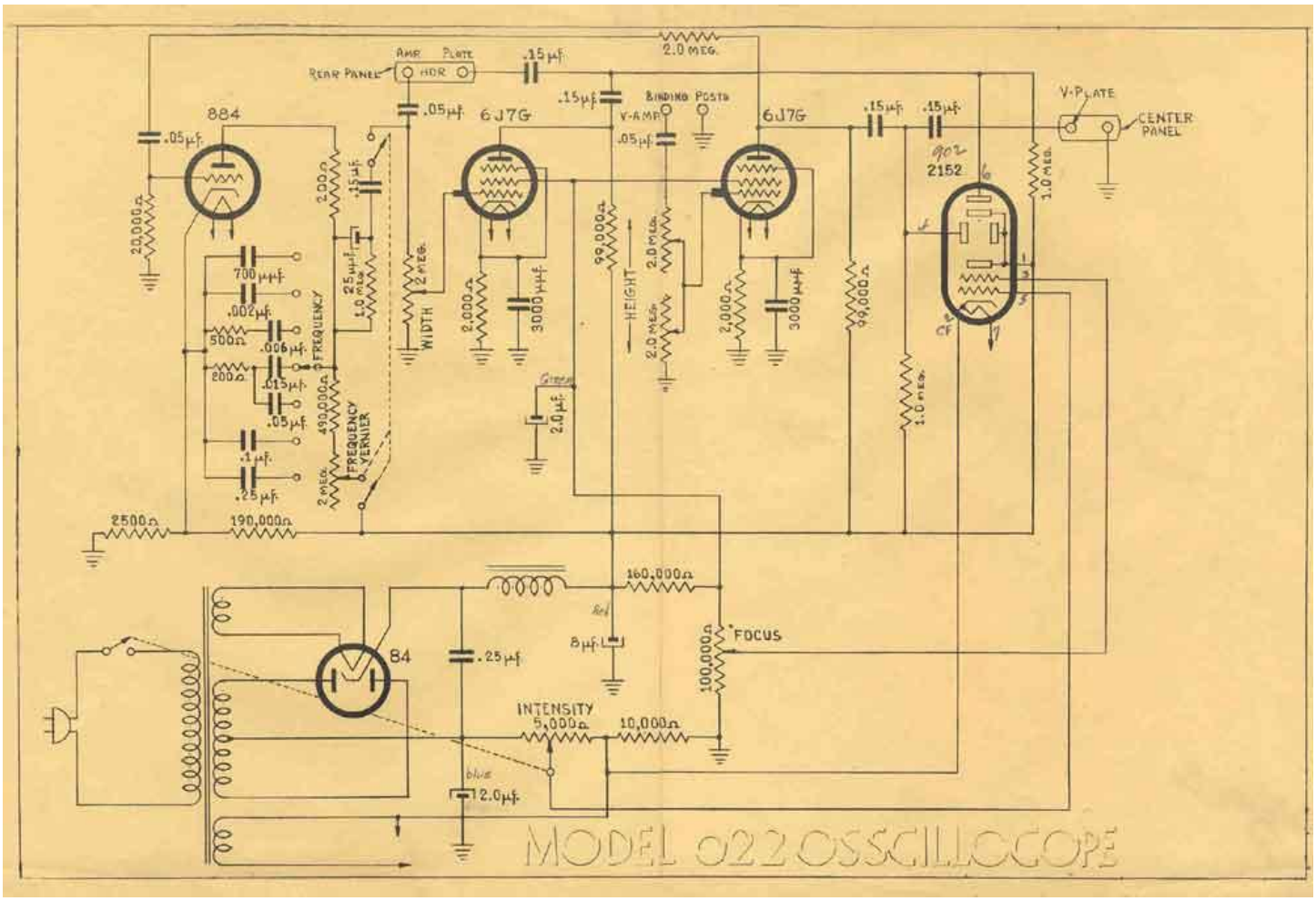

Courtesy of Chuck Azzalina